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Results of Groundwater Monitoring for the 300 Area Process Trenches

Reporting Period: January–June 2006

J. W. Lindberg

October 2006

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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Summary

This report is one of a series of semiannual groundwater monitoring reports on the corrective action program at the 300 Area process trenches. It fulfills requirements of WAC 173-303-645(11)(g) to report on the effectiveness of the corrective action program. This report covers groundwater monitoring data collected during the period from January through June 2006.

The objective of the groundwater monitoring plan is to demonstrate the effectiveness of the corrective action program by examining the trend of the contaminants of interest to confirm that they are attenuating naturally. The overall concentration of uranium in network wells decreased during the years 1998 to 2001, but has been holding relatively stable since 2001 in most wells downgradient of the 300 Area process trenches. Two wells, 399-1-16A and 399-1-10A, have shown a decrease since 2004. However, rising water-table conditions during high river stages occasionally mobilizes vadose zone uranium and temporarily increases concentrations of uranium in the aquifer, as reported in this and earlier semiannual reports. The concentration of cis-1,2-dichloroethene appears to be holding steady at levels above the drinking water standard (70 μg/L) in one well (399-1-16B) and is not affected by river stage.

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1.0 Introduction

The 300 Area process trenches (316-5) are a *Resource Conservation and Recovery Act* (RCRA) treatment, storage, and/or disposal unit in the Hanford Facility RCRA Permit (Ecology 2004). From 1975 through 1994, the trenches received effluent discharges of dangerous mixed waste from fuel fabrication laboratories in the 300 Area. Groundwater monitoring at the 300 Area process trenches is conducted in accordance with Washington Administrative Code (WAC) 173-303-645(11), "Corrective Action Program," and Part VI, Chapter 1 of the Hanford Facility RCRA Permit (Ecology 2004). The modified closure plan (DOE 1995), portions of which are incorporated into the Hanford Facility RCRA Permit, indicates that groundwater remediation is deferred to the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) 300-FF-5 Groundwater Operable Unit.

This report is one of a series of semiannual groundwater monitoring reports on the corrective action program at the 300 Area process trenches. It fulfills requirements of WAC 173-303-645(11)(g) to report on the effectiveness of the corrective action program. This report covers groundwater monitoring data collected during the period from January through June 2006.

2.0 Objective

The objective of groundwater monitoring during the corrective action period is to demonstrate the effectiveness of the corrective action program by examining the trend of the constituents of interest to confirm that they are attenuating naturally, as expected by the CERCLA record of decision for the 300-FF-5 Operable Unit (ROD 1996). The 300 Area process trenches were closed under a modified closure/post-closure plan (DOE 1995) and continue to be in the groundwater corrective action program because groundwater contamination continues to exceed groundwater quality criteria (federal drinking water standards). Groundwater monitoring will continue for 30 years during the post-closure monitoring period.

3.0 RCRA Groundwater Monitoring Program

The groundwater monitoring network for the 300 Area process trenches (Lindberg et al. 1995) includes four well pairs (see Figure 1). Each of the well pairs has one shallow and one deep well. The shallow wells are screened at the water table, and the deep wells are screened at the bottom of the unconfined aquifer (above the lacustrine and over-bank deposits of the Ringold Formation lower mud unit). One of the pairs is upgradient, and the other three pairs are downgradient. The constituents of interest are total uranium[1] and the volatile organic compounds cis-1,2-dichloroethene, trichloroethene, and tetrachloroethene. Sampling frequency is semiannual, but during each semiannual sampling period the wells are sampled four times (monthly intervals). As a result, the wells are sampled during the months of January, February, March, June, July, August, September, and December. Groundwater samples are analyzed for the contaminants of interest. Well data from wells other than the 300 Area process trenches network (300-FF-5 Operable Unit wells) are used as supplementary information to construct larger-scale water table and uranium concentration maps that extend beyond the area of the 300 Area process trenches network.

4.0 Groundwater Flow Direction

Measurements of depth to groundwater in each 300 Area process trenches network well were collected when the wells were sampled in January, February, March, and June 2006. In addition, depths to water at most of the wells in the 300 Area were measured on June 15, 2006, specifically for the purpose of gathering data (over a short period of time) to construct a water-table map for the 300 Area. Furthermore, depths to water were measured again in many of these wells for the 300-FF-5 Operable Unit June 2006 sampling event (June 22–27, 2006). (Note: 300 Area process trenches wells are a subset of the 300-FF-5 wells, and sampling events are coordinated such that there is no duplication of effort between the two projects.)

Figure 2 shows the configuration of the water table and uranium concentrations in the upper portion of the unconfined aquifer (e.g., "A" wells) just prior to the reporting period (December 2005). At that time, the water table was predominately in its normal (low river stage) configuration, and the flow direction in the northern portion of the 300 Area near the 300 Area process trenches was south to southeast. The water table generally conforms to this configuration throughout most of the year except during periods of high river stage as in the late spring and early summer. Figure 3 shows the configuration of the water table on June 15, 2006, when the overall water table was as much as 2 meters higher (than December 2005 levels) in response to the high river stage at that time. The contours in the northern portion of the 300 Area near the process trenches show a southwesterly gradient and groundwater flow direction. A specific conductance value of 351 μS/cm measured at well 399-1-17A on June 23, 2006, indicates bank storage of river water was occurring, and river water was partially mixing with groundwater as far inland as that well. (Note: Typical specific conductance values for undiluted groundwater in the unconfined aquifer of the 300 Area and river water generally range from 450 to 500 μS/cm and 140 to 160 μS/cm, respectively.) Several days later during the June sampling event for the 300 Area process

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[1] Groundwater monitoring objectives of RCRA, CERCLA, and the *Atomic Energy Act* (AEA) often differ slightly and the contaminants monitored are not always the same. For RCRA regulated units, monitoring focuses on non-radioactive dangerous waste constituents. Radionuclides (source, special nuclear and by-product materials) may be monitored in some RCRA unit wells to support objectives of monitoring under the AEA and/or CERCLA. Please note that pursuant to RCRA, the source, special nuclear and by-product material component of radioactive mixed wastes, are not regulated under RCRA and are regulated by DOE acting pursuant to its AEA authority. Therefore, while this report may be used to satisfy RCRA reporting requirements, the inclusion of information on radionuclides in such a context is for information only and, may not be used to create conditions or other restrictions set forth in any RCRA permit.

trenches and 300-FF-5 Operable Unit (June 22–27), the river stage and corresponding water levels in wells along the Columbia River had already begun dropping, and flow direction had resumed its typical southeasterly direction (Figure 4). However, the overall water-table elevation was still nearly a meter over its overall elevation in December 2005. Groundwater response to river stage is described in detail in previous semiannual reports on the RCRA 300 Area process trenches and in annual reports of the Groundwater Performance Assessment Project (e.g., Hartman et al. 2004, 2005, 2006).

5.0 Groundwater Contaminant Trends

This section discusses concentrations of uranium, cis-1,2-dichloroethene (cis-DCE), trichloroethene, and tetrachloroethene (the contaminants of interest) in the well network during the reporting period. Table 1 lists the analytical results for each contaminant of interest in each well of the monitoring network.

Uranium. A persistent uranium plume continued to underlie a large portion of the 300 Area (Figure 2 – December 2005, just prior to the reporting period; Figure 4 – June 2006, at the end of the reporting period). The maps include additional uranium data from wells sampled and analyzed for the 300-FF-5 Operable Unit. CERCLA and RCRA sampling and analysis are coordinated to avoid duplication of effort and to provide consistency for data interpretation purposes. The most concentrated portion of the plume in December 2005 (or early January 2006) was along the river in the southeastern portion of the 300 Area. This zone of highest concentration represents the downgradient expression of a commingled uranium plume from the 300 Area process trenches and another source to the south. In June 2006, there were two zones of elevated uranium concentration located farther inland from the river. The northern zone of elevated uranium concentration is near the 300 Area process trenches (Figure 4). These changes in positions of the highest uranium concentrations in the 300 Area reflect the influence of Columbia River stage on the water table. When the river stage rose in June 2006 (as a result of spring runoff), the corresponding rise in the water table caused bank storage of river water that, in turn, caused dilution of uranium in the aquifer along the Columbia River for at least 100 meters (Figure 4). Furthermore, the rise in the water table mobilized uranium stored in the lower portions of the vadose zone at locations more than 100 meters from the river (where there is little or no bank storage).

Uranium was detected in seven of the eight network wells during the reporting period. However, uranium concentrations exceeded the drinking water standard (30 μg/L) only at the three downgradient network wells that are screened at the water table (399-1-10A, 399-1-16A, and 399-1-17A). The highest concentration reported in the network wells was 155 μg/L at well 399-1-17A in a sample collected June 23, 2006. Uranium concentration trends at wells 399-1-10A and 399-1-16A (Figures 5 and 6), although generally showing slightly decreasing trends in the last 2 years, show a dramatic concentration decrease in June 2006 in response to the elevated river level, elevated water table, and mixing of groundwater with river water during bank storage. Conversely, the uranium concentration at well 399-1-17A rose significantly over the relatively stable trend during the last 5 years when the substantial rise in water table during June 2006 mobilized additional uranium near the 300 Area process trenches (Figure 7). Response of the water table and uranium concentration in the 300 Area to river stage is described in detail in previous semiannual reports on the RCRA 300 Area process trenches and in annual reports of the Groundwater Performance Assessment Project (e.g., Hartman et al. 2004, 2005, 2006).

Cis-1,2-Dichloroethene. Cis-1,2-dichloroethene (cis-DCE) was detected at four wells in the 300 Area process trenches network during the reporting period (399-1-16A and B, and 399-1-17A and B). The B wells are screened in the lower portion of the unconfined aquifer, and the A wells are screened at the water table. Only well 399-1-16B had concentrations of cis-DCE that exceeded the drinking water standard (70 μg/L). At well 399-1-16B, the concentrations during the reporting period ranged from 120 to 150 μg/L. The trend at well 399-1-16B (Figure 8) is variable but overall appears to be neither decreasing nor increasing. At the other three wells where cis-DCE was detected, the concentration never exceeded 3.6 μg/L during the reporting period.

Trichloroethene. Trichloroethene (drinking water standard 5 μg/L) was detected at four wells in the 300 Area process trenches network during the reporting period (399-1-16A and B; 399-1-17A and B). The well with the highest reported concentration during the reporting period was well 399-1-16B with a value of 2.4 μg/L. This well is screened at the base of the unconfined aquifer, and the source was most likely the 300 Area process trenches. The historical trend at this well shows that trichloroethene concentrations decreased since 1997, but have remained relatively stable at levels below the drinking water standard since 2000. The source of trichloroethene at the other well (399-1-16A, screened at the water table) is uncertain, but may be from the 300 Area process trenches or from an offsite source to the southwest (Hartman et al. 2006, Figure 2.12 through 2.14).

Tetrachloroethene. In recent years, tetrachloroethene (5 μg/L drinking water standard) has occasionally been detected in the well network downgradient of the 300 Area process trenches. During the reporting period, it was not detected at levels above the method detection limit (0.19 μg/L).

6.0 Conclusions

The objective of the groundwater monitoring plan is to demonstrate the effectiveness of the corrective action program by examining the trend of the contaminants of interest to confirm that they are attenuating naturally. The overall concentration of uranium in network wells decreased during the years 1998 to 2001, but has been holding relatively stable since 2001 in most wells downgradient of the 300 Area process trenches. Two wells, 399-1-16A and 399-1-10A, have shown a decrease since 2004. However, rising water-table conditions during high river stages occasionally mobilizes vadose zone uranium and temporarily increases concentrations of uranium in the aquifer, as reported in this and earlier semiannual reports. The concentration of cis-DCE appears to be holding steady at levels above the drinking water standard (70 μg/L) in one well (399-1-16B) and is not affected by river stage.

7.0 References

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Table 1. Results of Groundwater Analyses for 300 Area Process Trenches Contaminants of Interest During January to June 2006

Well	Sample Date	cis-1,2-Dichloroethene (µg/L)		Tetrachloroethene (µg/L)		Trichloroethene (µg/L)		Uranium (µg/L)	
399-1-10A	01/18/2006	0.19	U	0.19	U	0.2	U	56.6	
	02/27/2006	0.19	U	0.19	U	0.2	U	35.3	
	03/16/2006	0.19	U	0.19	U	0.2	U	20.8	
	06/22/2006	0.19	U	0.19	U	0.2	U	16.8	
399-1-10B	01/18/2006	0.19	U	0.19	U	0.2	U	0.0132	U
	02/21/2006	0.19	U	0.19	U	0.2	U	0.0539	U
	03/16/2006	0.19	U	0.19	U	0.2	U	0.108	
	06/22/2006	0.19	U	0.19	U	0.2	U	0.0178	U
399-1-16A	01/18/2006	0.19	U	0.19	U	0.46	J	58.8	
	02/27/2006	0.38	J	0.19	U	0.63	J	48.7	
	03/16/2006	0.19	U	0.19	U	0.26	J	46	
	06/23/2006	0.19	U	0.19	UN	0.2	U	11.8	
399-1-16B	01/24/2006	140	DQ	0.19	U	1.6	Q	8.7	
	02/21/2006	120	D	0.19	U	2		11.6	
	02/21/2006	140	D	0.19	U	2.1		10	
	03/16/2006	120	D	0.19	U	1.5		10.6	
	06/23/2006	150	D	0.19	UN	2.4		10.4	
399-1-17A	01/24/2006	0.19	U	0.19	U	0.2	U	47.7	
	02/21/2006	0.8	J	0.19	U	0.2	U	30.5	
	03/23/2006	0.19	U	0.19	U	0.23	J	46.4	
	06/23/2006	0.19	U	0.19	UN	0.4	J	155	
399-1-17B	01/10/2006	1.9		0.19	U	0.2	U	0	U
	01/24/2006	0.23	J	0.19	U	1.5		0.00317	U
	02/21/2006	3.6		0.19	U	0.2	U	0	U
	03/23/2006	2.7		0.19	U	0.2	U	0	U
	06/23/2006	3		0.19	UN	0.2	U	0.01	U
399-1-18A	01/18/2006	0.19	U	0.19	U	0.2	U	5.94	
	02/21/2006	0.19	U	0.19	U	0.2	U	5.69	
	03/23/2006	0.19	U	0.19	U	0.2	U	5.87	
	06/23/2006	0.19	U	0.19	U	0.2	U	6.19	
399-1-18B	01/20/2006	0.19	U	0.19	U	0.2	U	0.0073	U
	02/21/2006	0.19	U	0.19	U	0.2	U	0.0784	
	03/23/2006	0.19	U	0.19	U	0.2	U	0	U
	06/23/2006	0.19	U	0.19	U	0.2	U	0.0144	U

D = Sample diluted for analysis.
J = Value is an estimate (close to detection limit).
N = Spike recovery was outside control limits.
Q = Associated quality-control out of limits.
U = Undetected.

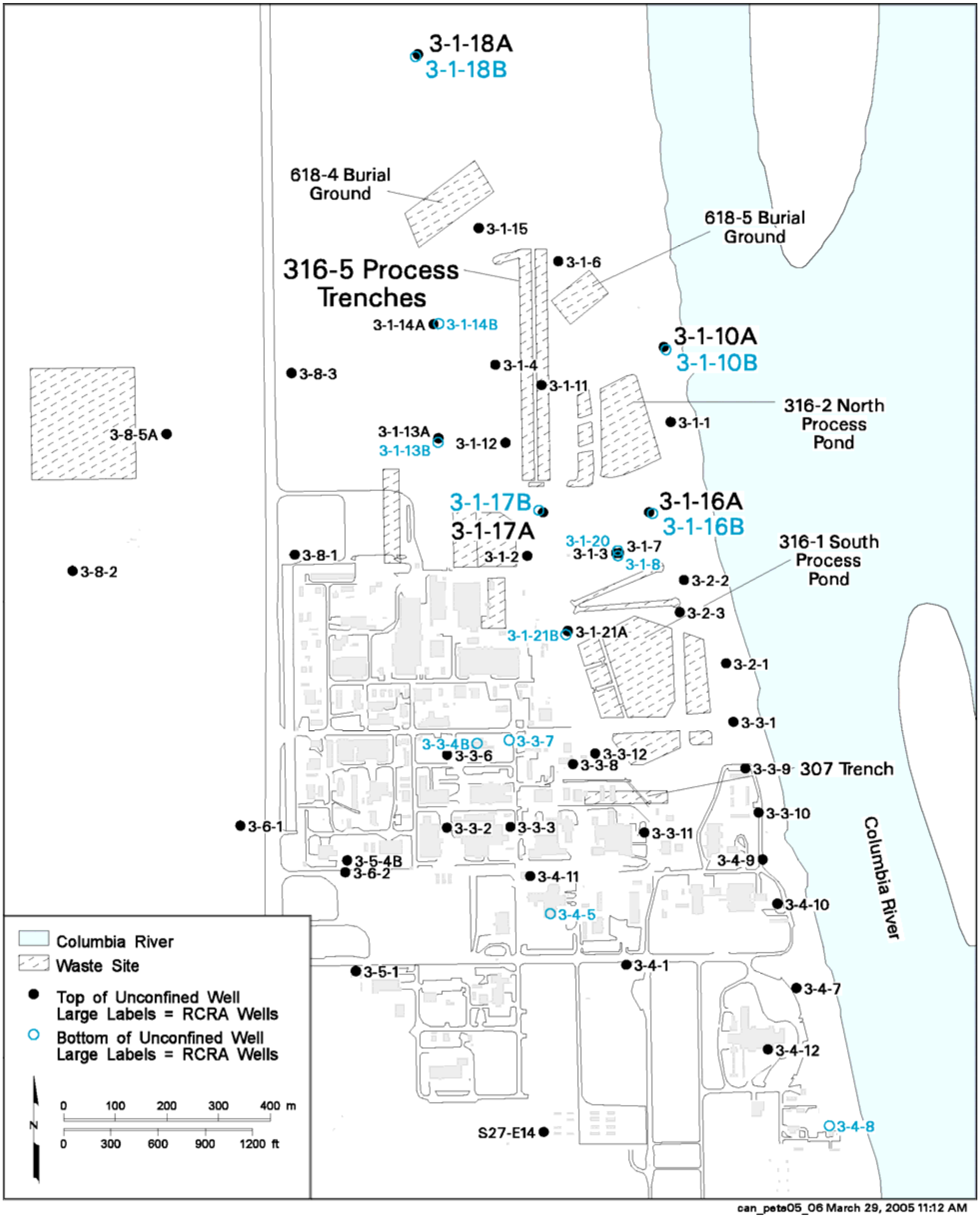

Figure 1. Locations of Wells in the 300 Area Process Trenches Monitoring Networks (from Lindberg et al. 1995). The four well pairs of the 300 Area process trenches network have larger labels.

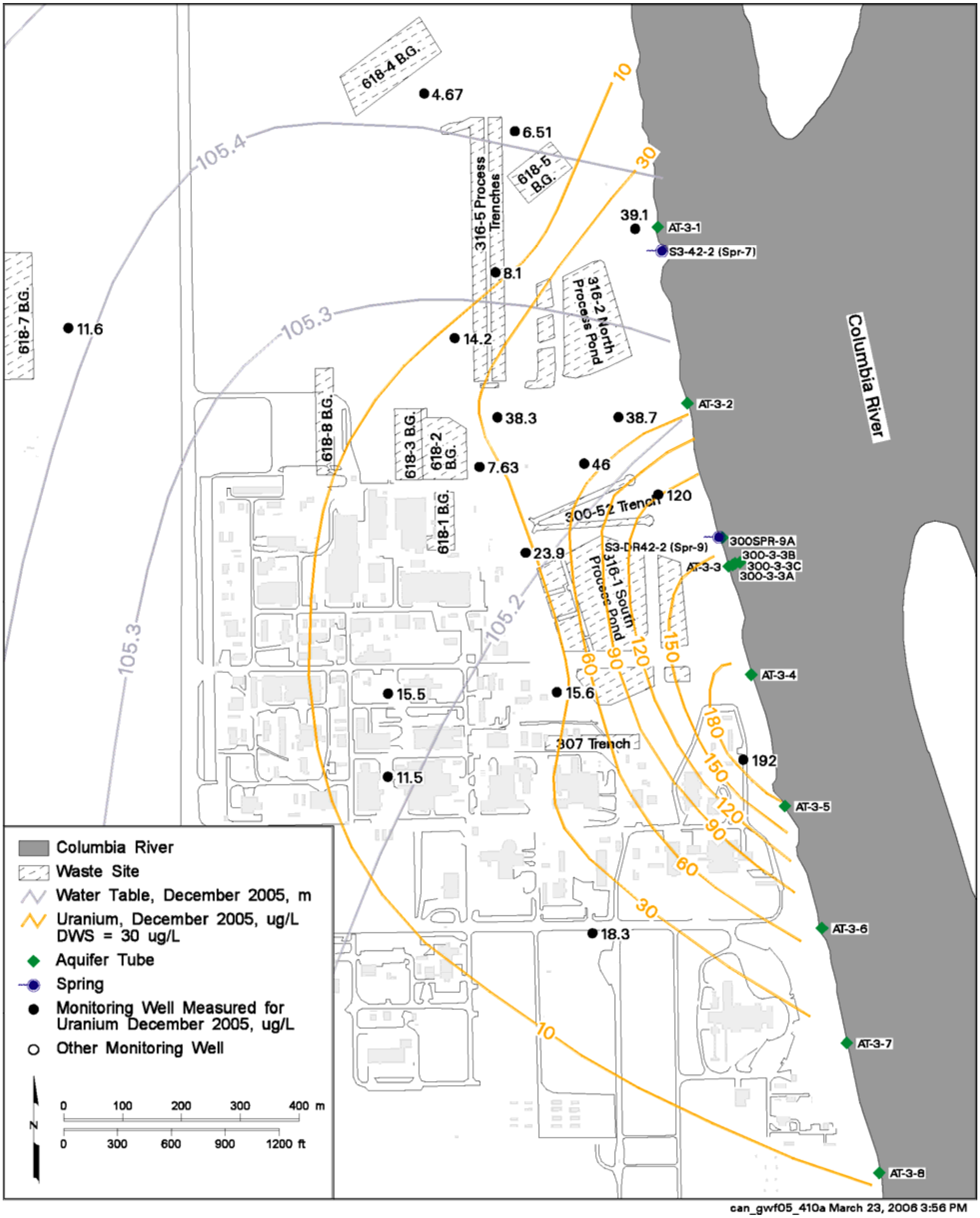

Figure 2. 300 Area Water Table and Uranium Concentrations in the Upper Portion of the Unconfined Aquifer, December 2005

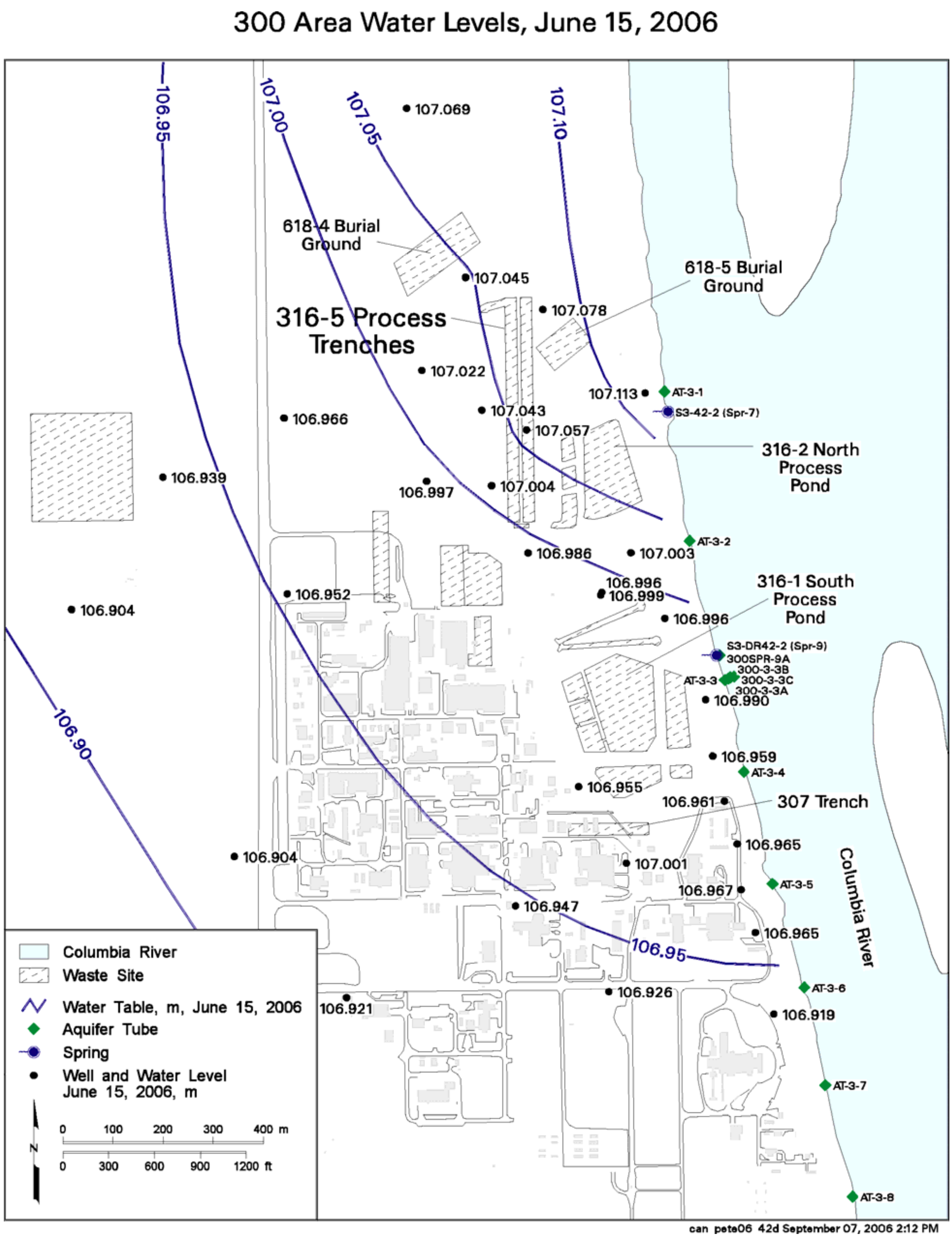

Figure 3. 300 Area Water Table, June 15, 2006

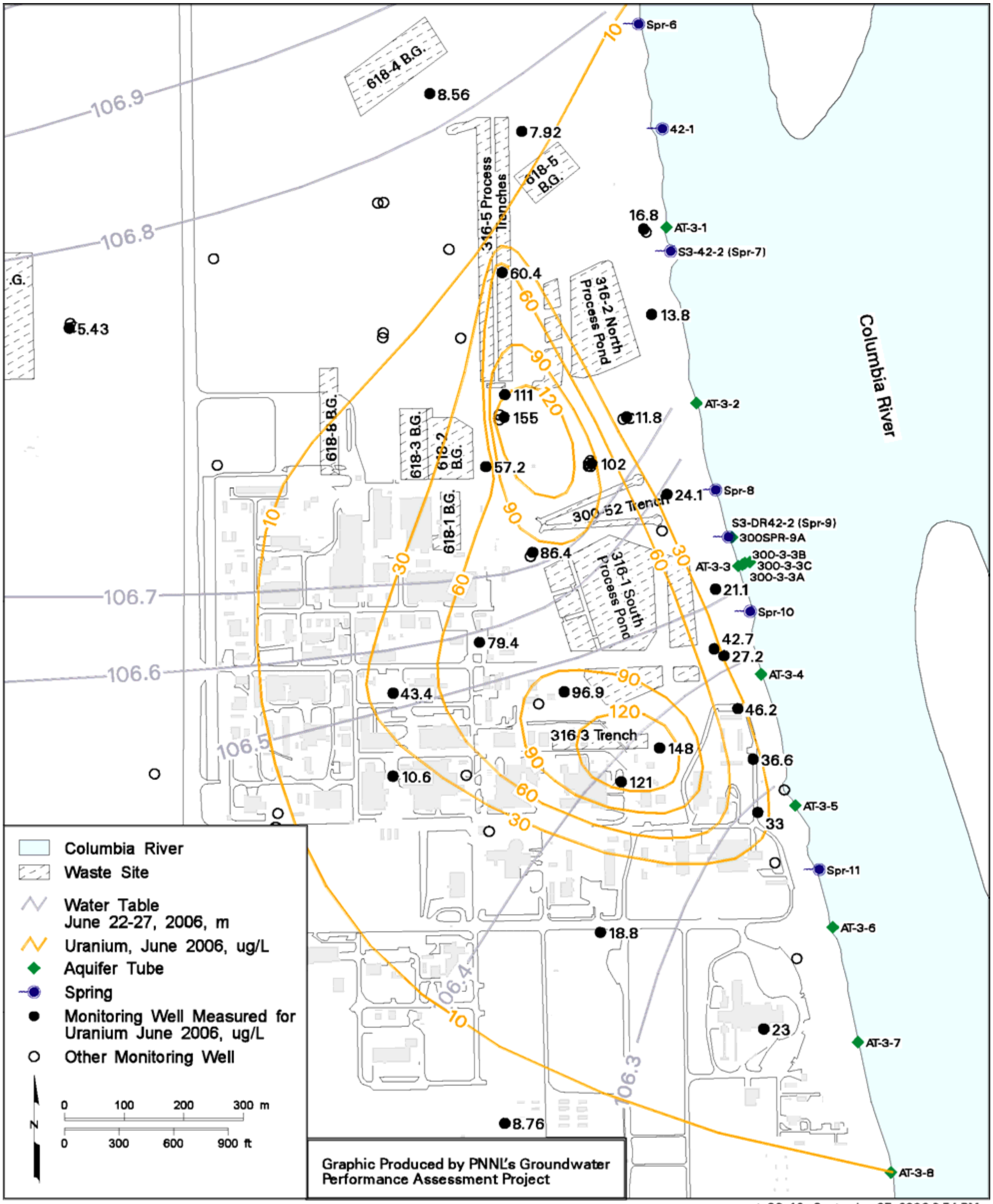

Figure 4. 300 Area Water Table and Uranium Concentrations in the Upper Portion of the Unconfined Aquifer, June 22–27, 2006

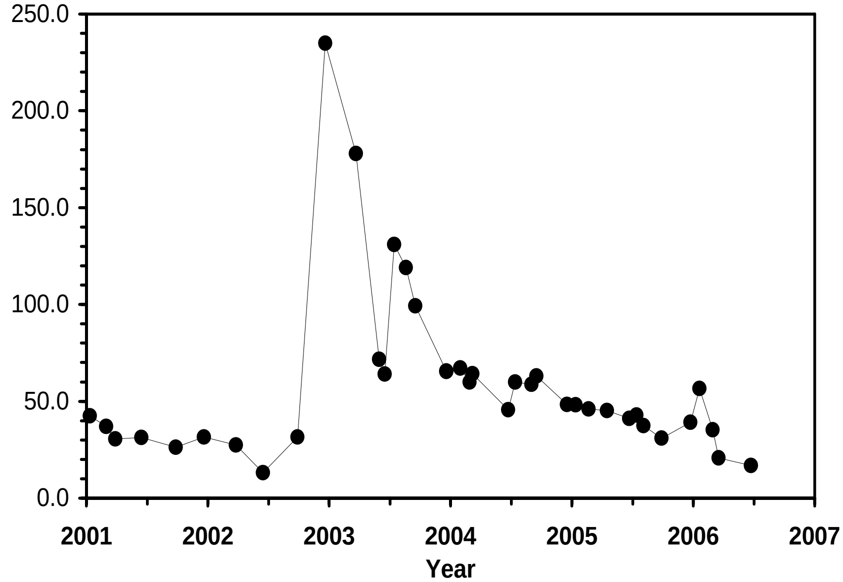

Figure 5. Uranium Concentrations in Well 399-1-10A

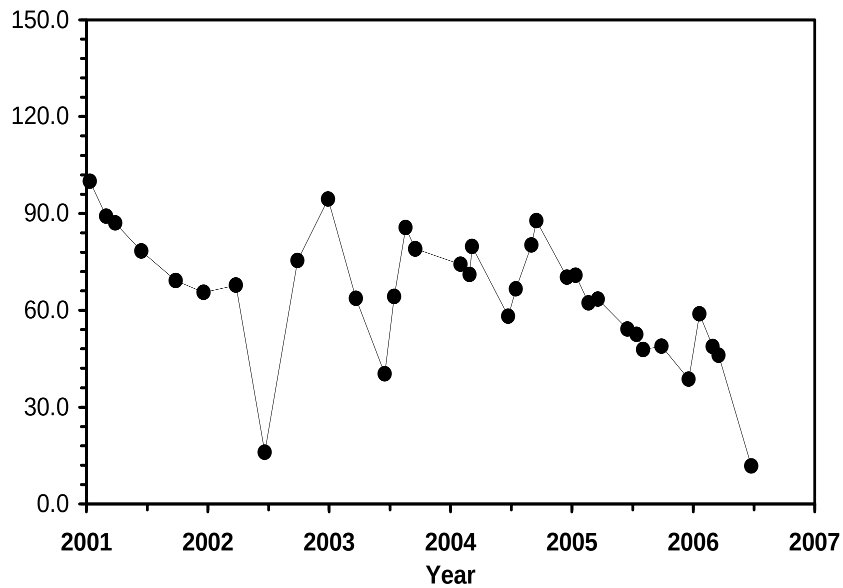

Figure 6. Uranium Concentrations in Well 399-1-16A

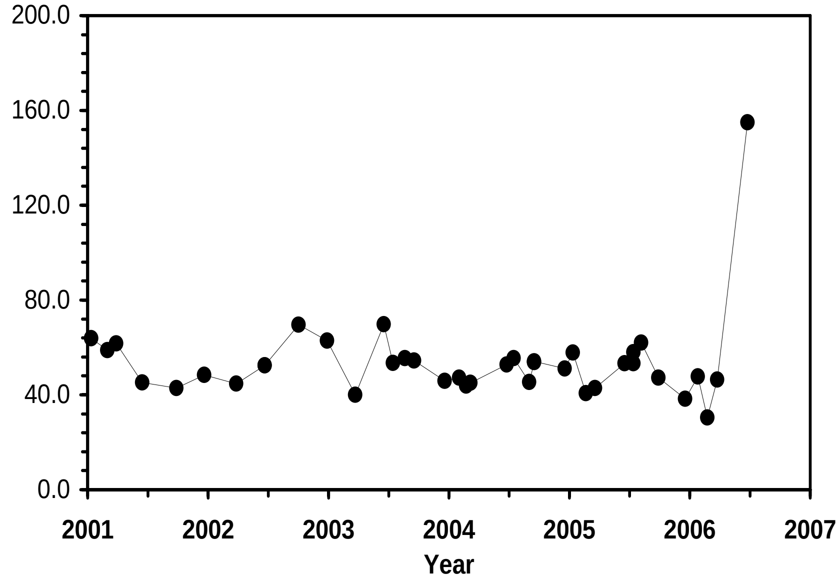

Figure 7. Uranium Concentrations in Well 399-1-17A

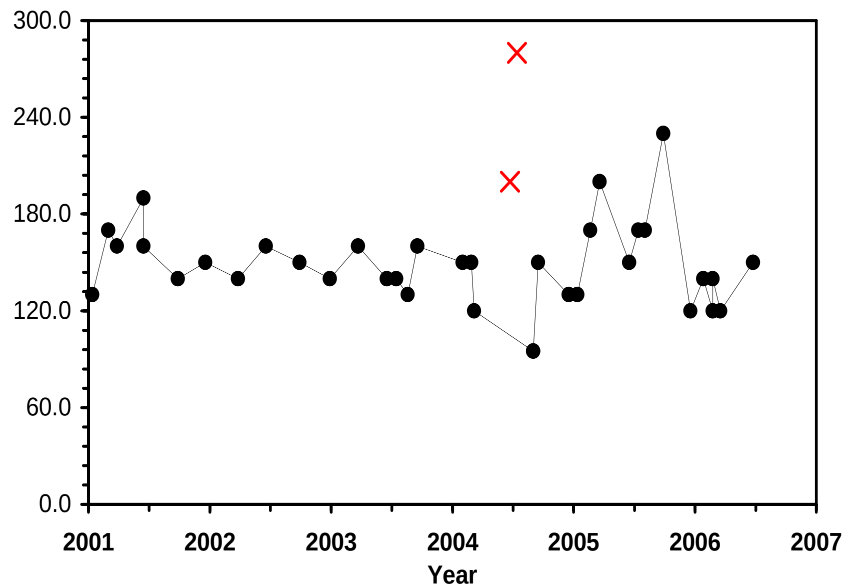

Figure 8. Cis-1,2-Dichloroethene Concentrations in Well 399-1-16B. Potential laboratory errors indicated by “X.”

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